

Didactic analysis of the items proposed in the competition test of entry to the CRMEF of the graduate professors qualifying option "physical chemistry" session 2015-2016 and determining factors in the choice of good future teacher

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ABSTRACT: The Regional Centers of Education and Training (CRMEF) in Morocco are responsible for recruiting and training candidates for the teaching of schools. Admission to the CRMEF is done first of all by a pre-selection on file. The selected candidates will then pass a written test in chemistry physics of duration of 4 hours. The written examination, in physics chemistry, written in the form of a multiple-choice questionnaire (MCQ) is established by the examination center of the Minister of National Education, Morocco. It consists of two parts, one dealing with physics and the other with chemistry. Each part is made up of totally independent parts. It contains 57 items divided into 11 themes. The physical part comprises 31 items divided into 6 themes and the chemistry part includes 26 items divided into 5 themes. The analysis of items includes all the statistical processes whose purpose is to evaluate the quality of an examination and the items that compose it.

The research work conducted here is not interested in the editorial aspects of the MCQ items. It focuses exclusively on the one hand to analyze the items of the written examination (MCQ) of the entrance examination to the CRMEF taking into account qualitative information via the statistical indicators of discrimination and difficulty and on the other hand to perceive if the structuring and the formulation of the MCQ items are decisive in the choice of good future teacher. To do this a detailed analysis of each item of the written exam (MCQ) was done. The results of this study show that among the 57 items in the written test (MCQ), there are 7% of the items to be revised and 10.5% to be rejected and consequently the proposed examination does not discriminate between applicants and did not allow an adequate choice of good future teacher.

KEYWORDS: Competition - Regional Center for Education and Training Trade (CRMEF) - - Item Analysis - School Teachers - Recruitment - MCQ Exam - Future Teacher - Discrimination Index - Difficulty Index - Determinant.

INTRODUCTION

Studies show that pupils receiving high-performance teachers will progress on average three times faster than those entrusted to inferior teachers [1,2]. Teachers must therefore be provided with the professional skills quality education and this requires professional development, in other words, through initial and in-service training for teachers [3].

CRMEF is primarily responsible for this performance by choosing future teachers and then qualifying them during the initial training they make available to them.

Similarly to other countries, the Minister of National Education in Morocco organizes, at the beginning of each school year, a competition for the recruitment of candidates holding a bachelor's degree, master's degree, professional degree in education science, or other diplomas equivalent to the regional centers of the trades of education and training (CRMEF) [4,5,6]. This is part of the training framework for teachers in the secondary school qualifying and collegiate in physical chemistry.

In this study, the method of evaluating the written test seems to us to be a crucial and decisive factor in the choice of good future teachers. However, detailed item-by-item analysis of the entire written test has shown that such a test does not further discriminate candidates and does not allow an adequate choice of a good future teacher.

RESEARCH CONTEXT

Given the importance of the evaluation process in the field of recruitment, of future teachers, we proceeded to a counting of the notes associated with each item of the written test (MCQ). A careful analysis of these notes suggests that two-thirds of the candidates who passed the written test found it very difficult to approach the examination as a whole and did not average. This observation allowed us to hypothesize: To what extent the quality of the items (good and/or bad discrimination) proposed in the written test of the entrance examination to the CRMEF is decisive in the choice of good future Teacher (tie-breaker).

To verify our initial hypothesis we carried out a detailed analysis of each item of the written test (MCQ) in analogy with the quantitative norms P and ID. An estimate of the mean difficulty index and the average discriminatory power of the entire written test was made.

THEORETICAL FRAME

The item analysis is the set of statistical processes whose purpose is to evaluate the quality of an examination and the items (ie the questions) that compose it. This type of analysis has several advantages:

- Obtain guidance on the accuracy and reliability of the results observed.
- "Validate" a review by removing gaps where necessary.
- Calibrate future exams.
- Create an "item bank".
- Improve wording of questions.

The three-item analysis reports [7] that are "the test analysis report", "item analysis report" and "item advice report" are used to identify issues that are problematic, they would merit revision or replacement for a forthcoming review session. They also help identify the "best" questions, which should be inspired when writing new questions (item analysis report, item advice report).

These last two reports are based on two important indicators: Difficulty / Facility Index (Pi), Discrimination index (ID).

Pi: Item Difficulty / Facility Index (ranging from 0 to 1) is the proportion of students who have just answered an item i. An item is all the easier because it has a high index * P * and it is therefore to aim that the majority of items are neither too easy nor too difficult: that their P is distributed around 0.5. How to value this value? McAlpine[8] considers that the answers are too difficult ($P < 0.15$, when less than 15% of respondents answered the question correctly), or too easy ($P > 0.85$, ie when at least 85% Have answered just) can be excluded from the MCQ. The first are "impossible", the second "trivial" and therefore neither allows the effective measurement of the skills of people passing the MCQ. (Fig.1, 2).

ID: Discrimination Index (ID) is a variant of the Pearson correlation coefficient and is called r a ripple point (rpbis)[9]. It varies, like any correlation coefficient, between -1 and 1, and corresponds to the correlation coefficient between an item and the total score on the test. It is then important to see to what extent a given question in itself contributes to selecting "good" or "less good" candidates. Figures 1 and 2 below give the range of variation of the quantitative norms P and ID.

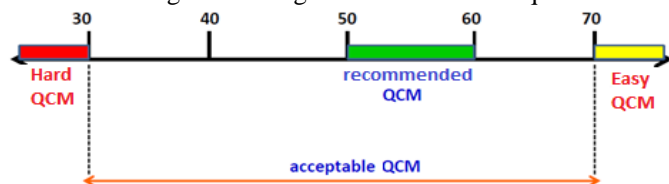


Figure (1) :Difficulty / Facility Index

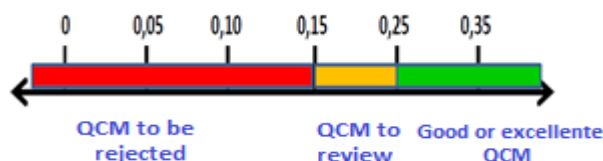


Figure (2) :Discrimination Index (ID)

RESEARCH METHODOLOGY

The number of candidates enrolled in the entrance examination to the CRMEF for the 2015 - 2016 school year is 1286 and of what are selected to pass the written test is ninety. The written exam in the form of multiple choice questionnaires (MCQ) comprises 57 items divided into 11 themes six themes in physics and five themes in chemistry. The 6 physics themes contain 31 items and the 5 chemistry themes encompass 26 items.

The sample used:

The current study was conducted on 30 pseudo-randomly selected copies of ninety copies of the candidates who passed the written test of the CRMEF entry competition for the academic year 2015-2016. Using the results (correct and/or false) obtained in each copy of the sample used, it was possible to assume the quantitative P and ID standards associated with each item (Table 1 and 2) of the written test.

A careful and parallel examination of the quantitative standards P and ID indices (difficulty and discrimination) was carried out in order to analyze finely the quality of the items proposed in the written test of the entrance examination to the CRMEF. The use of the results (correct and/or false) obtained in each copy of the sample used allowed the P and ID standards associated with each item (Table 1 and 2) to be assumed in the written test of the competition.

RESULTS AND DISCUSSION: Detailed statistical analysis and discussion of each item in the written test

1.1. Physical:

- Theme: mechanical :To verify our initial hypothesis, we carried out a detailed analysis of the different items of the written test A careful and parallel examination of the last two indices (P and ID) (Table 1, Fig. a) allows a fine analysis of the quality of the items. It is noted that items Q_3 and Q_4 have a very low difficulty / ease index equal to 0.1 and 0.03 respectively are both less than 0.15 ie less than 10% respectively 3% of the candidates answered just the question. The latter two percentages are very low,

which means that questions Q_3 and Q_4 are difficult to reach by the candidates, and the latter also have negative indices of discrimination (ID) (-0.23 and -0.16). Which means that it is the unsatisfactory candidates in general (on the whole questionnaire) who succeed well in these items, which may suggest that these items are a weak predictor of knowledge or skill measured in the test, And therefore we must consider its suppression, or that successful candidates in general succeed less well with these items: it is appropriate in this case to ask why. This suggests that the items Q_3 and Q_4 are non-discriminating and therefore to reject or reformulate or that the disciplinary level of candidates and very low. While the items, Q_6 and Q_5 have a difficulty rating of 0.2 and 0.23 less than 0.3 (less than 30% of the candidates responded correctly) means that these questions are difficult [10]. Is it normal that so many candidates have not met the objective measured by these questions? The difficulty index of questions Q_2 , Q_9 and Q_{10} (0, 37, 0.4 and 0.4) is distributed around 0.5: these items are neither too easy nor too difficult (acceptable questions) [8]. The item Q_8 with an index of difficulty $0.4 < P = 0.53 < 0.6$ a little more than 0.50 and discrimination index $0.15 < ID = 0.18 < 0.24$: question Discriminates well [9]. The question Q_7 at $P = 0.23$ with a negative discrimination coefficient ($ID < 0$) shows an inconsistency: the best candidates fail this question when the weak candidates succeed. This question with ID must be withdrawn from the bank. The remaining item on this theme Q_1 (60% of candidates answered just) has a discrimination index of 0.36: excellent question [10].

- Theme: electronic :This topic includes only two items Q_{11} and Q_{12} (Table 1, Fig. b) that have a difficulty index of 0.67 and 0.37 respectively (67% and 37% of the candidates responded correctly). The discrimination index of Q_{11} is $ID = 0.47$ and that of Q_{12} is $ID = -0.13$. This suggests that item Q_{11} is an issue that discriminates very well and that item Q_{12} is a non-issue Real interest in a certification assessment [11].
- Theme: magnetism :The items, Q_{13} , Q_{14} and Q_{15} of the magnetism theme (Table 1, Fig. c) have a Difficulty / Facility Index (P) which is in the range $0.4 < P < 0.6$ a little more than 0, 50 and a discrimination index (ID) (in absolute value) $-0.05 < ID < 0.12$: these items are neither too easy nor too difficult (acceptable questions) [8]. While item Q_{17} has a difficulty / ease index ($P = 0.13 < 0.15$) non-discriminatory question and therefore to reject or reformulate or that the disciplinary level of candidates and very low and the item Q_{16} has a difficulty / ease index ($P = 0.3$) (30% of the candidates answered just) with an ID of - 0.19: difficult question [10].
- Theme: electrostatic: Question Q_{18} , (Table 1, Fig. d), has a difficulty / ease index($P = 0.57 < 0.6$): this item is neither too easy nor too difficult (an acceptable question) [8]. While item Q_{21} of difficulty / ease index ($P = 0.07 < 0.15$): 7% of the candidates answered just. This too difficult question does not discriminate so should be discarded from the MCQ. The items, Q_{19} and Q_{20} have a difficulty / ease index that is very close to 0.35 are classified as excellent questions (good discriminates). The remaining item Q_{22} has an index $P = 0.17$ between 0.15 and 0.24: marginal issue: to be revised.
- Theme: optics : In this theme the items (Table 1, Fig. e), Q_{23} , Q_{24} , Q_{25} , Q_{26} and Q_{28} have an index P which is distributed around 0.5 which means that the majority of the items are neither too easy nor too Difficult. For item Q_{27} only 10% of respondents answered just the given question, which proves that it is difficult (less discriminating).
- Theme: wave: The difficulty / ease index of the two items Q_{29} , and Q_{30} is less than 0.24: marginal questions: to be revised[8]. The last question Q_{31} ($P = 0.43$: 43% answered just this question) is discriminating (Table 1, Fig.f).

Table 1 : Levels of candidates byphysicaltheme

THEMES	Item	Coef/Item	ERJ	ERF	ERN	FRJ(%)	P	PQR(%)
MECHANIC	Q_1	2	18	9	3	60	0.6	20
	Q_2	2	11	16	3	37	0.37	
	Q_3	3	3	24	3	10	0.1	
	Q_4	2	1	28	1	3	0.03	
	Q_5	1	7	23	0	23	0.23	
	Q_6	2	6	24	0	20	0.2	
	Q_7	2	7	21	2	23	0.23	
	Q_8	2	16	11	3	53	0.53	
	Q_9	2	12	15	3	40	0.4	
	Q_{10}	2	12	14	4	40	0.4	
ELECTRONIC	Q_{11}	2	20	10	0	67	0.67	50
	Q_{12}	3	11	16	3	37	0.37	
MAGNETISM	Q_{13}	2	13	15	1	43	0.43	20
	Q_{14}	2	16	13	1	53	0.53	
	Q_{15}	2	13	16	1	43	0.43	
	Q_{16}	2	9	18	3	30	0.3	
	Q_{17}	2	4	22	4	13	0.13	
ELECTROSTATIC	Q_{18}	2	17	12	1	57	0.57	10

	Q ₁₉	2	9	19	2	30	0.3	
	Q ₂₀	2	10	19	1	33	0.33	
	Q ₂₁	2	2	25	3	7	0.07	
	Q ₂₂	2	5	19	6	17	0.17	
OPTIC	Q ₂₃	2	15	15	0	50	0.5	17
	Q ₂₄	2	9	14	7	30	0.3	
	Q ₂₅	1	10	10	10	33	0.33	
	Q ₂₆	2	11	11	8	37	0.37	
	Q ₂₇	2	3	26	1	10	0.1	
	Q ₂₈	2	9	17	4	30	0.3	
WAVES	Q ₂₉	2	7	22	1	23	0.23	0
	Q ₃₀	1	7	21	2	23	0.23	
	Q ₃₁	1	13	16	1	43	0.43	

PQR
ERJ
ERF
ERN

Proportion of successful questions
Effect of fair answers
Effect of false answers
Effect of non-response questions

FRJ
P
Coef/Item

Frequency of correct answers
Index of difficulty
Coefficient par Item

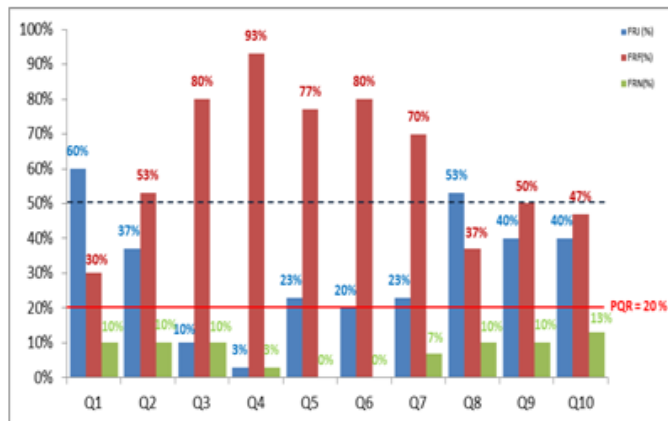


Figure (a) : Success and failure rates in mechanics

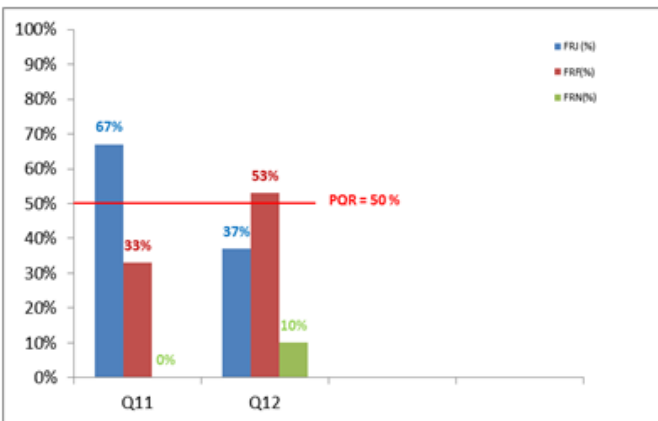


Figure (b) : Success and failure rate in electronics

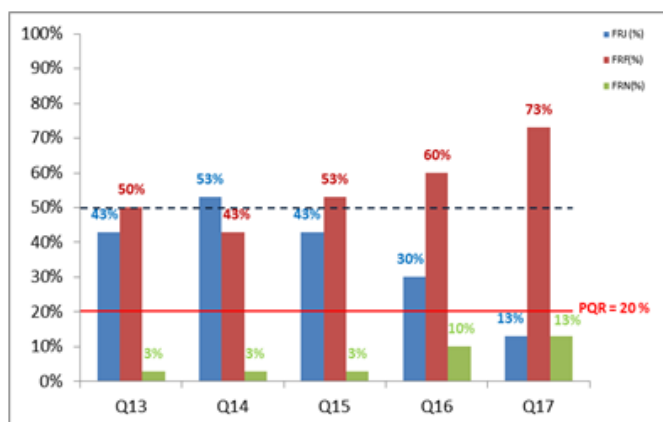


Figure (c) : Success rate and magnetism failure

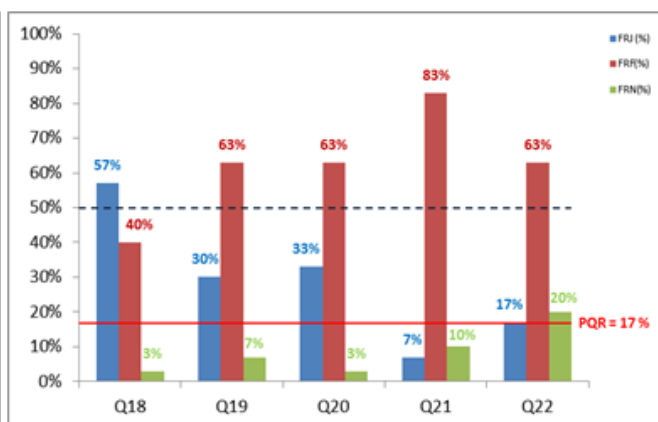


Figure (d) : Electro static Success and Failure Rates

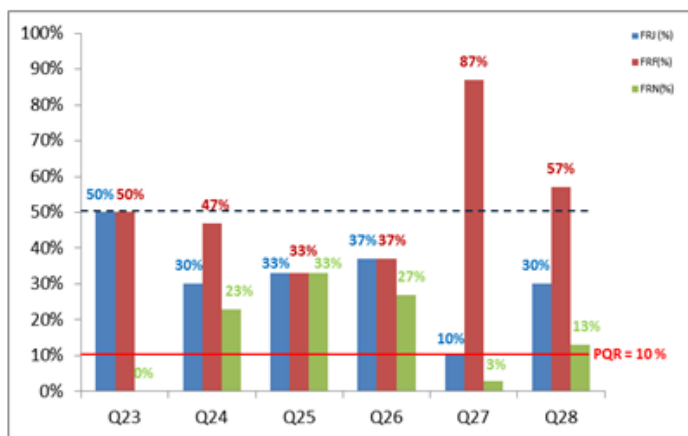


Figure (e) : Success and Failure Rates in Optics

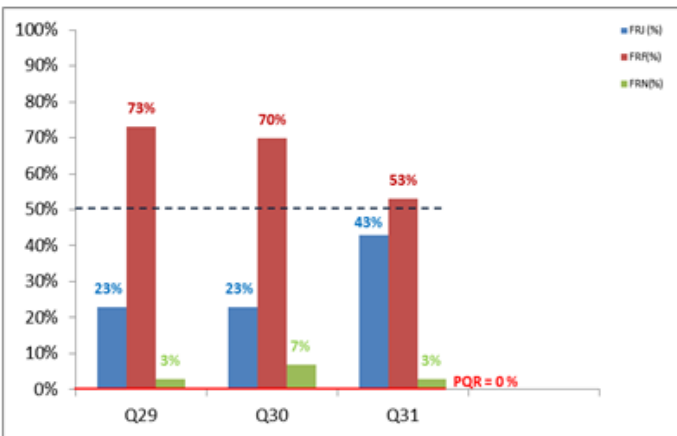


Figure (f) : Wave success rate and failure rate

1.2. Chemistry

- Theme: structure of matter :It consists of six items (Table 2, Fig. g), three of which are too easy "trivial", Q₃₂, Q₃₅ and Q₃₆ with a difficulty / ease (P) index of 0.9, 0.83 and 0.87 all greater than or equal to 0.85. These questions where all the candidates succeed (P > 0.85) are not sufficiently informative because they do not discriminate candidates. Moreover, if the examination includes only very easy or very difficult questions, it does not make it possible to discriminate two average candidates since both will succeed all the easy questions and will fail to all the very difficult questions, so they will both same rating. These items should be excluded from the MCQ [8]. Items Q₃₃ and Q₃₇ both have nearly the same difficulty / ease index equal to 0.6 (ie 60% of the candidates answered just) discriminate well (excellent questions). The remaining item Q₃₄ has an index P = 0.23 between 0.15 and 0.24: marginal question: to be revised.
- Theme: chemical thermodynamics : Questions Q₃₈, Q₄₀, Q₄₁ and Q₄₂ of the chemical thermodynamic theme (Table 2, Fig. h) all have a difficulty / Ease (P) index which is in the range 0.3 <P <0.7 and a Discrimination (ID) which is in the range 0.25 <ID <0.34 which suggests that these items are acceptable (good questions). Item Q₃₉ of difficulty / ease index P = 0.53 and discrimination index ID > 0.35 is an excellent question [8].
- Theme: reactions in aqueous media :The three items, Q₄₃, Q₄₄ and Q₄₇ of the reactions in aqueous solution (Table 2, Fig. i) contain a difficulty/facility (P) index that settles in the range 0.3 <P <0.7 and one Index of discrimination in the range 0.25 <ID <0.34 which suggests that these items are acceptable (good questions). Items Q₄₆ and Q₄₈ are questions of average difficulty (P = 0.50), it will discriminate correctly the average subjects, but will not discriminate weak subjects among themselves (because they will fail all questions) or (because they will succeed all the questions). The remaining item Q₄₅ has a difficulty/ease index equal to 0.13: question too difficult.
- Theme: Chemical kinetics :The chemical kinetic theme (Table 2, Fig. j) contains five items. Items Q₅₀ and Q₅₂ both have a Difficulty / Ease (P) index of less than 0.15 and therefore are too difficult. While the other three, Q₄₉, Q₅₁ and Q₅₃ have an index P in the range 0.3 <P <0.7 and a discrimination index (ID) that is in the range 0.25 <ID <0.34 which suggests that these items are acceptable (good questions).
- Theme: organic chemistry : The four items, Q₅₄, Q₅₅, Q₅₆ and Q₅₇, of the organic chemistry theme (Table 2, Fig. k) all have a Difficulty / Facility Index (P) which intercalates on the interval 0.3 <P <0.7 And a discrimination index (ID) that finds in the range 0.25 <ID <0.34 and therefore are good questions.

Table 2 : Level of candidates bychemicaltheme

THEMES	Item	Coef/Item	ERJ	ERF	ERN	FRJ(%)	P	PQR(%)
STRUCTURE OF MATTER	Q ₃₂	2	27	2	1	90	0.9	83,33
	Q ₃₃	1	19	10	1	63	0.63	
	Q ₃₄	1	7	21	2	23	0.23	
	Q ₃₅	1	25	4	1	83	0.83	
	Q ₃₆	2	26	2	2	87	0.87	
	Q ₃₇	1	18	11	1	60	0.6	
CHEMICAL THERMODYNAMICS	Q ₃₈	2	9	21	0	30	0.3	20
	Q ₃₉	2	16	11	3	53	0.53	
	Q ₄₀	2	9	20	1	30	0.3	
	Q ₄₁	2	13	15	2	43	0.43	
	Q ₄₂	2	13	16	1	43	0.43	

REACTIONS IN AQUEOUS MEDIA	Q ₄₃	1	23	6	1	77	0.77	50
	Q ₄₄	3	9	15	6	30	0.3	
	Q ₄₅	3	4	22	4	13	0.13	
	Q ₄₆	2	15	14	1	50	0.5	
	Q ₄₇	2	14	10	6	47	0.47	
	Q ₄₈	1	15	12	3	50	0.5	
CHEMICAL KINETICS	Q ₄₉	1	8	20	2	27	0.27	0
	Q ₅₀	1	1	27	2	3	0.3	
	Q ₅₁	1	10	17	3	33	0.33	
	Q ₅₂	2	2	21	7	7	0.07	
	Q ₅₃	1	7	18	5	23	0.23	
ORGANIC CHEMISTRY	Q ₅₄	1	14	14	2	47	0.47	50
	Q ₅₅	1	16	11	3	53	0.53	
	Q ₅₆	1	20	8	2	67	0.67	
	Q ₅₇	1	9	19	2	30	0.3	

PQR
ERJ
ERF
ERN

Proportion of successful questions
Effect of fair answers
Effect of false answers
Effect of non-response questions

FRJ

P

Coef/Item

Frequency of correct answers
Index of difficulty
Coefficient par Item

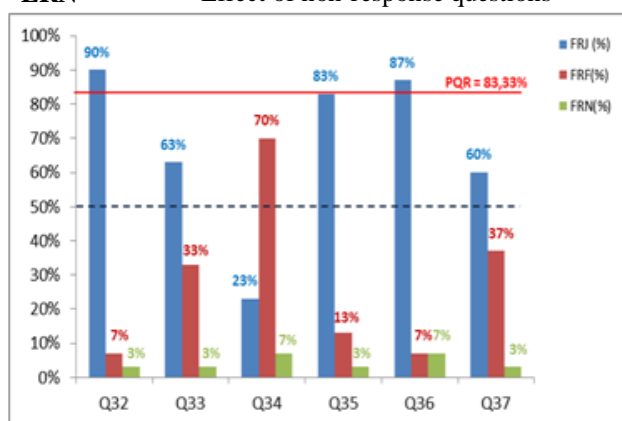


Figure (g) : Success rate and failure rate in material structure

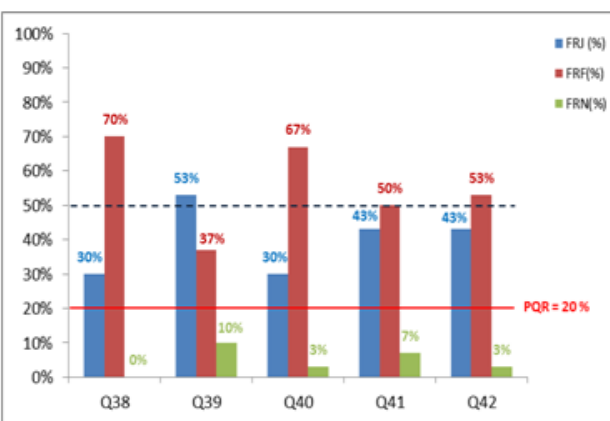


Figure (h) : Success and failure rates in chemical thermodynamics

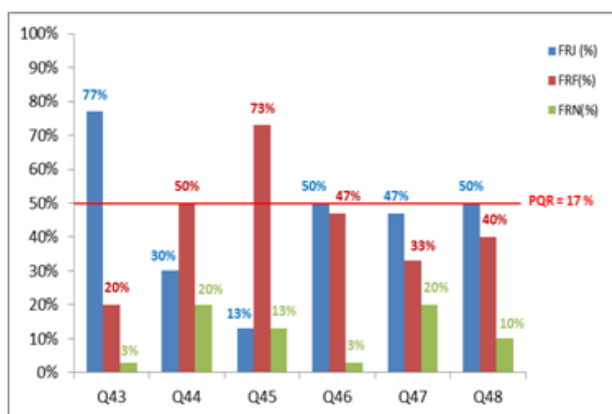


Figure (i) : Success rate and failure rate in aqueous solution reactions

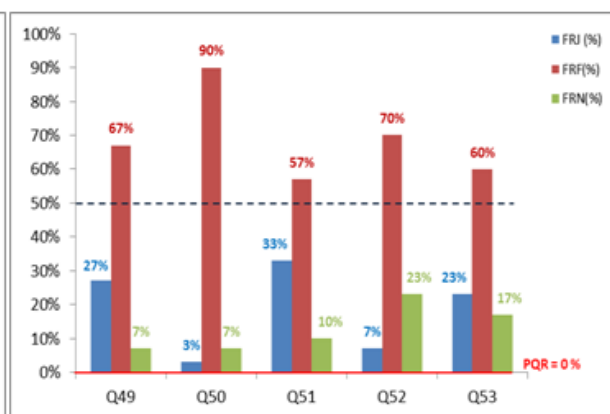


Figure (j) : Success rate and failure rate in chemical kinetics

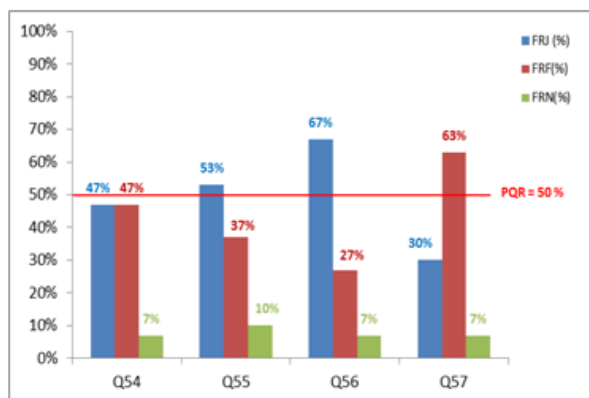


Figure (k) : Success and Failure Rates in Organic Chemistry

CONCLUSION

The careful analysis of the 57 items of the written test (MCQ) divided into 11 themes (6 themes in physics including 31 items and 5 themes in chemistry comprising 26 items) led us to conclude that:

- The average difficulty index of the test was optimal, ie 0.41;
- Items classified as good or excellent were moderately predominant, accounting for 52% of the total;
- Difficult items accounted for 17.5% of the questions with wide variations within disciplines;
- Average items accounted for 12.3% of total questions;
- The percentage of questions to be revised (7%) and / or rejected (10.5%) is relatively large compared to all items.
- The discriminating power of the whole test was average, an average discrimination index of 0.28. Discrimination issues accounted for 17.5% of the total, 7% to be revised and 10.5% to be rejected. The best discrimination was found for difficult disciplines ranging from 0.4 to 0.6.

The analysis of items showed that the test was of relatively acceptable internal consistency and of medium quality in terms of difficulty and discrimination. They tended to be easy and discriminated mainly between middle students. Ongoing analysis will further improve their quality.

The result thus obtained showed that the difficulties encountered by the candidates.

The written test are related not only to the disciplinary deficiencies but also to the way in which it is structured the written test (MCQ) which suggests that this test is not decisive in the choice of good future teacher.

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